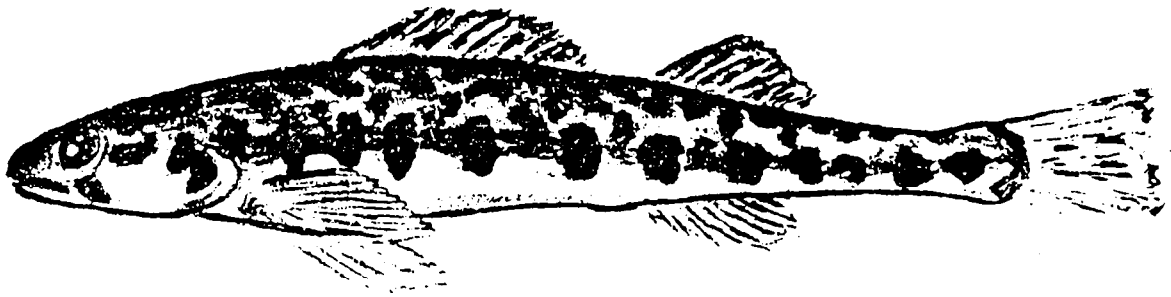


LEOPARD DARTER

RECOVERY PLAN



1984

Albuquerque, New Mexico

RECOVERY PLAN FOR THE LEOPARD DARTER

(Percina pantherina Moore and Reeves)

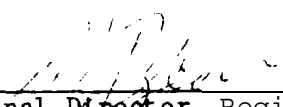
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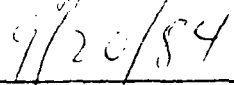
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Albuquerque, New Mexico

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Regional Director, Region 2
U.S. Fish and Wildlife Service

DATE:



SUMMARY

1. Point or condition when species will be considered for delisting:

The leopard darter can be **delisted** when all important areas of leopard darter habitat have been identified, are no longer threatened by adverse modification, and the continued existence of the species in its habitat is assured.

2. What must be done to reach **recovery**:

Steps to reach recovery include identification and protection of important habitat and gaining additional information, through research, concerning unknown aspects of the species life history.

3. Management needs to keep the species recovered:

To keep the species recovered, it will be necessary to provide adequate protection and management of important habitat. This must include entering into land **management** agreements with private landowners,, informing State and Federal agencies which have land holdings adjacent to streams inhabited by leopard darters of the status of the darter and ensuring these agencies consider the species in their management plans, and monitoring of leopard darter populations to assure continued survival of viable populations.

DISCLAIMER

This is the completed Leopard Darter Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies (and it does not necessarily represent the views of all recovery team members/individuals) who played the key role in preparing this plan. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

The Recovery Plan for the Leopard Darter, dated September 1984, ~~was~~ prepared by the U.S. Fish and Wildlife Service under contract with Mr. Ray N. Jones, Purchase Order Number 20181-0189-83.

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PART I - RECOVERY

Introduction

Before 1977, only 165 leopard darters (Percina pantherina) had been collected (Robison 1978) and little was known about the species. The rareness of leopard darters led several authors to recommend special protection (Miller 1972, Buchanan 1974, **Cloutman** and Olmsted 1974, Robison 1974, Robison et al. 1974, **Seehorn** 1975, Hubbs and Pigg 1976).

The U.S. Fish and Wildlife Service (1978) determined the leopard darter to be a threatened species on January 27, 1978, thereby giving it full protection under the Endangered Species Act of 1973 (43 FR 3715). Critical habitat was designated that includes the following portions of the Little River system:

1. Main channel of the Little River from the mouth of Cloudy Creek upstream to the Pushmataha and Le Flore County line.
2. Black Fork Creek from its junction with Little River upstream to Oklahoma Highway 144 bridge crossing.
3. Main channel of Glover Creek from Oklahoma Highway 7 bridge crossing upstream to the junction of the East Fork and West Fork of Glover Creek.
4. Main channel of the East Fork of Glover Creek from its junction with the West Fork of Glover Creek upstream to a point 4 air miles north-northeast of the community of Bethel, Oklahoma.

5. Main channel of the West Fork of Glover Creek from its junction with the East Fork of Glover Creek upstream to the community of Battiest, Oklahoma.
6. Main channel. of the Mountain Fork Creek from the mouth of Boktukola Creek upstream to the community of Mountain Fork, Arkansas.

Taxonomy

Moore and Reeves (1955) described the leopard darter as Hadropterus pantherinus. When Hadropterus was synonymized under the genus Percina by Bailey et al. (1954), the current name Percina pantherina was established for the species (Robison 1978). Fish currently recognized as leopard darters were captured much earlier than 1955, including the earliest known collections which were made by O.P. Hay in 1884 (Robison 1978). Subsequently, a single specimen was collected in 1925 from the upper reaches of ~~the~~ Mountain Fork River near Potter, Arkansas, by an expedition of the University of Oklahoma Zoology Museum (Hubbs and Ortenburger 1929). The leopard darter is closely related to the blackside darter (Percina maculata) but is readily ~~dis-~~tinguished from the latter on the basis of two main characteristics: scales are smaller (81-84 scales in the lateral line versus 62-77) and the 11-14 dark blotches along the lateral band are square or round and tend to be deeper than long. The eye is dark and there are well-developed preorbital, suborbital, and postorbital bars. Dark spots or blotches and saddles cover

the dorsum. Color is light olive above and whitish below. Some specimens have faint traces of three bars on the **caudal** fin but relatively little pigment on the other fins. Maximum size is about 3 inches (Miller and Robison 1973).

Distribution and Abundance

The leopard darter is endemic to the Little River system in southeastern Oklahoma and southwestern Arkansas (Miller and Robison 1973). Very little data are available concerning historical distribution and abundance because most of the Little River **drainage was** inaccessible and early collecting efforts were restricted. Prior to 1977, 64 separate collecting efforts from 30 different locations resulted in collection of only 165 leopard darters. Thirty leopard darters were taken from 3 locations in the upper Little River, 55 from 14 locations in Glover Creek, 44 from 9 locations in the Mountain Fork River, and 36 from 4 locations in the Cossatot River (Figure 1). The largest populations occurred in Glover Creek (Taylor and Wade 1972, Eley et al. 1975). A complete list of collections made prior to 1977 can be found in Robison (1978:23-28). Interestingly, leopard darters have not been collected **from the** Rolling Fork or Saline Rivers in Arkansas (Figure 1). Apparently, the species is distributed relatively widely but is most abundant in the upper reaches of the Little **River** and its major tributaries. However, the limited numbers collected would seem to indicate that the leopard darter never reached high densities anywhere within its range.

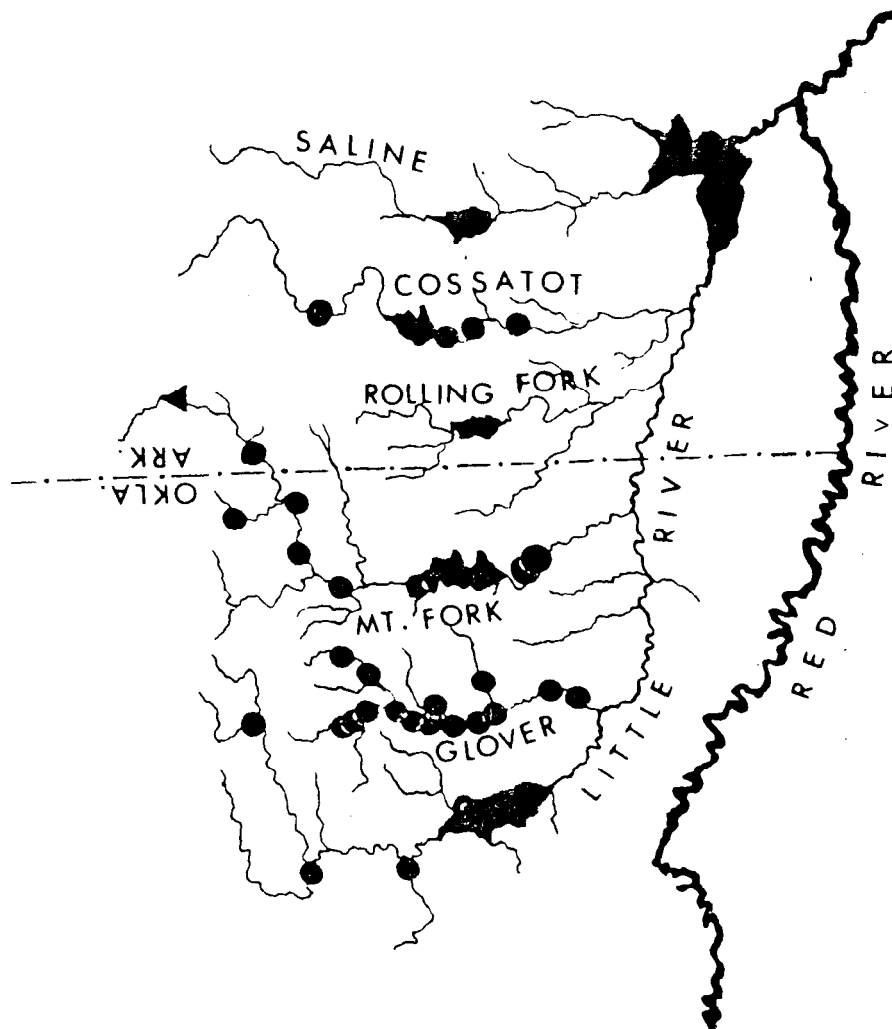


Figure 1. Known locations of leopard darter occurrence in the Little River system prior to 1977 (Robison 1978).

Since 1977, the leopard darter has been studied extensively in the Glover Creek drainage, with sporadic observations outside this drainage. Robison (Jones et al. 1979) collected or observed over 30 leopard darters at the State Highway 4 Bridge crossing on the Cossatot River, Howard County, Arkansas, and estimated that densities ranged from 0.016 to $0.072/\text{m}^2$ using an enclosure technique and 2.19 to $7.64/100$ m of stream using snorkeling techniques. In 1979, Thomas O. Duncan, U.S. Fish and Wildlife Service, Arkadelphia, Arkansas, reported a leopard darter from below Pine Creek Reservoir on the Little River and another specimen from below **Gillham** Reservoir on the Cossatot River (O.E. Maughan pers. **comm.**). Two leopard darters also were collected by **the** Oklahoma Cooperative **Fishery** Research Unit in the Little River near Nashoba, Oklahoma, during the **summer** of 1982 (A. Rutherford pers. **comm.**). .

From August 1977 to July 1980, 139 leopard darters were collected at 14 different locations in the Glover Creek drainage (Table 1 and Figure 2) (Jones et al. 1984). Site 4 on Cedar Creek, near where Taylor and Wade (1972) reported capturing a single specimen, was the only site sampled where leopard darters were not collected. Of the 139 leopard darters collected, 88 were taken in the East and West Forks of Glover Creek, 47 from the main channel, and 4 from Pine and Carter Creeks. Leopard darter densities ranged from 0 to $0.0170/\text{m}^2$, or 0 to $27/100$ m of stream (Table 2). **Low denisities** appear to be characteristic for all darter species in Glover Creek (Jones 1981). Data on the relative abundance of darters in Glover Creek indicate that the leopard darter is the second **most** abundant darter species in the drainage (Table 3, Jones et al. **1984**), although this should not underemphasize the leopard darter's extremely low absolute abundance.

Table 1. Number of leopard darters collected at each sampling location shown in Figure 2 in Glover Creek from August 1977 to July 1980 (Jones et al. 1984.)

Site ^a	Number of Leopard Darters
1	3
2	8
3	11
4	0
5	2
6	3
7	17
8	1
9	3
10	3
11-R	5
11-P	33
12	5
13	5
14-R	11
14-P	29

^aR = riffle; P = pool

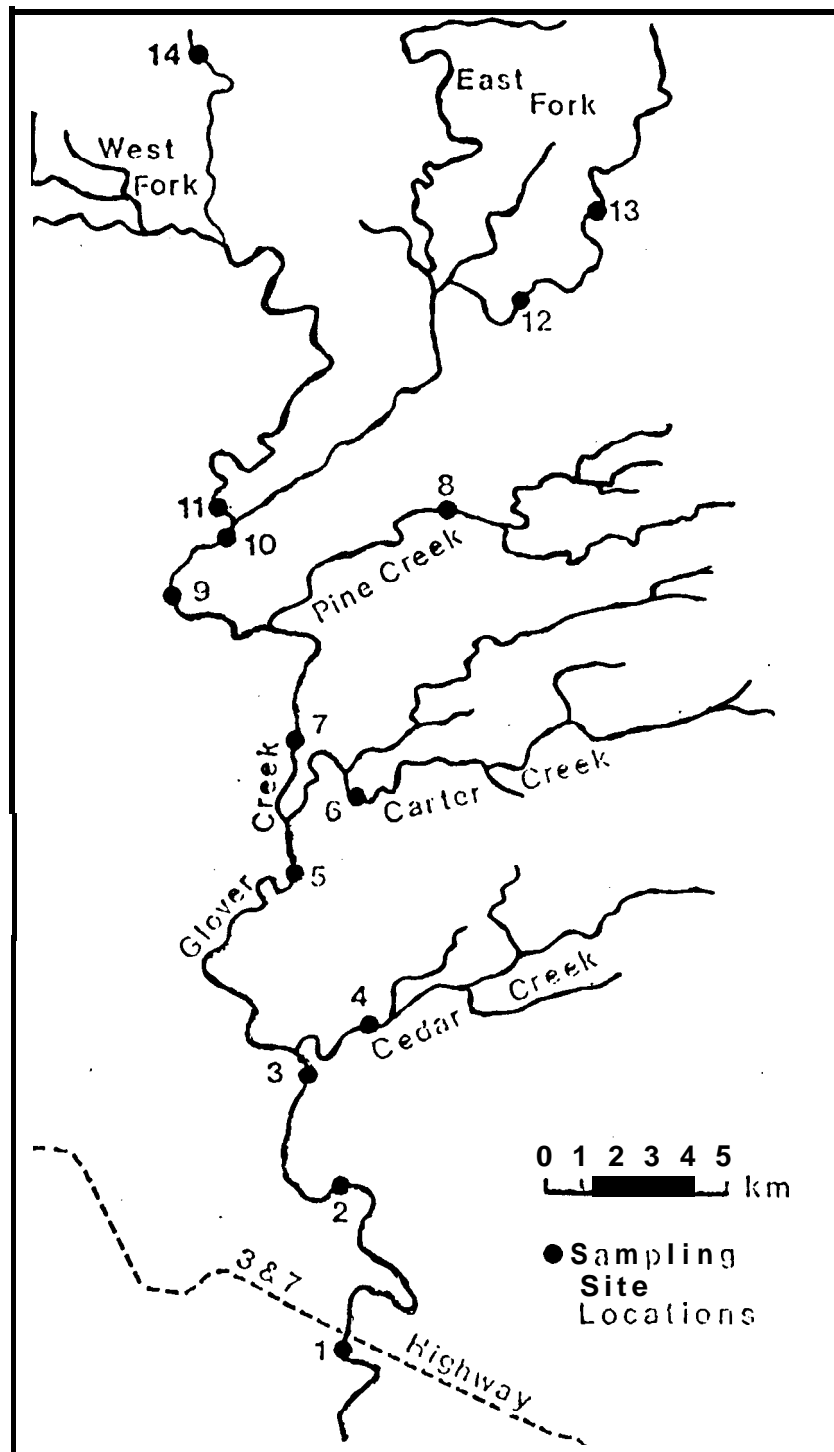


Figure 2. Sampling locations on Glover Creek, Oklahoma, during the study by Jones et al. 1984.

Table 2. Total catch and estimated **maximum** and mean densities of leopard darters collected during population estimates in Glover Creek from August 1977 to July 1980 (Jones et al. 1984).

*Site ^a	Number of estimates	T o t a l Catch	No. /m ²		No. /100m stream	
			Max.	x	Max.	x
3	5	1	0.0022	0.0004	2.4	0.5
7	3	3	0.0024	0.0005	5.8	2.9
11-R	8	4	0.0042	0.0007	7.0	1.1
11-P	12	32	0.0134	0.0031	27.0	6.2
12	7	5	0.0071	0.0025	6.4	2.3
14-R	10	11	0.0170	0.0030	14.6	2.7
14-P	11	28	0.0165	0.0041	24.3	6.0

^aR = riffle; P = pool.

*Site numbers refer to sampling locations shown in Figure 2.

Table 3. Total catch and percent of total catch for each darter species collected in Glover Creek from August 1977 to July 1980 (Jones et al. 1984.)

Species	Total Catch	Percent of Total Catch
<u>Etheostoma radiosum</u>	8,054	98.2
<u>E. nigrum</u>	14	0.2
<u>E. spectabile</u>	28	0.3
<u>Percina caprodes</u>	68	0.8
<u>P. copelandi</u>	3	1.0
<u>P. pantherina</u>	119	1.4
<u>P. sciera</u>	9	0.1

Available data indicate that the leopard darter population has remained stable throughout most of Glover Creek and at several locations in the Cossatot River. Insufficient data are available to evaluate leopard darter populations in other tributaries. No data pertaining to distribution and abundance of **subadult** leopard darters are available.

Ecology and Life History

Habitat--Adult leopard darters typically are associated with the upland reaches of the Little River and its major tributaries. **Streams** are characterized by relatively steep gradients that drain **mountainous** or hilly terrain, **with** rubble, boulder, and bedrock bottoms. Leopard darters are **most** often found in larger and intermediate **streams** and typically do not inhabit smaller **headwater** tributaries. They are, however, occasionally collected in smaller streams (Roblson 1978, Jones et al. 1983).

All the early literature described the leopard darter as a riffle dwelling species (Moore and Reeves 1955, Oklahoma Biological Survey 1972, **Cloutman** and Olmstead 1974, Eley et al. 1975). However, **more** recent data demonstrates that moderately **shallow** pool areas are the preferred habitat of adult leopard darters. Most observations and collections of leopard darters in the Cossatot River by Robison (Jones et al. 1979) were made in pool habitats, despite considerable sampling effort to collect them in adjacent riffles. Jones et al. (1984) observed that leopard darters in Glover Creek occurred most frequently in pool habitat during

all seasons, although specimens occasionally were captured in riffles and runs during winter and spring (Table 4). Quantitative measurements of leopard darter relative density within various intervals of water depth, water velocities, and substrates showed that densities were highest at depths of 20 to 79 cm, at velocities of 0 to 19 cm/s, and in rubble and boulder substrate types (Jones et al., 1984).

Water Quality--Water quality was good in streams where leopard darters were collected. The following water quality characteristics were listed by Eley et al. (1975): Water temperature, 0°C in winter to 33°C in summer; dissolved oxygen, 4.0 mg/l in summer to 15.0 mg/l in winter; total dissolved solids, 20 to 100 mg/l; suspended solids, 20 to 100 mg/l; apparent color units, 10 to 150; pH, 6.5 to 8.0; CaCO₃ total alkalinity, 10-15 mg/l; total phosphorus < 0.01 to 0.30 mg/l; total nitrogen, < 0.5 to 6.5 mg/l.

Food Habits--The only data on the food habits of the leopard darter are those of Robison (1978) who examined the stomachs of 7 museum specimens. Primary items found in the stomach contents were Simulium sp., Pseudocloen and the dipterans Chironomidae and Chadboridae (Table 5). Fragments of coleopteran and green algae also were found.

Age and Growth--Of the 165 specimens collected prior to 1977, 88 were examined by Robison (1978) for age and growth. The smallest individual, not examined by Robison, was 22 mm (SL). The largest specimen was a female 76.8 mm (SL) and was over 3 years old. Of the 139 leopard darters

Table 4. Number of leopard darters captured in each general habitat type during each season (Jones et al. 1984).

Season	Frequency			
	Pool	Run	Riffle	Total
Fall	16	1	1	18
Winter	37	5	8	50
Spring	27	13	2	42
Summer	29	0	0	29
Total	109	19	11	139

Table 5. Percentage frequency and average number of items found in seven stomach of Percina pantherina (Robison 1978).

Taxon	Frequency*	Ave.. No.**
Ephemeroptera		
Baetidae		
<u>Pseudocloen</u> sp.	57.1	7.0
Coleoptera (?)	14.3	1.0
Diptera		
Simuliidae		
<u>Simulium</u> sp.	71.4	49.4
larvae	71.4	48.0
pupae	14.3	7.0
Chironomidae	28.6	2.0
Chaoboridae		
<u>Chaoborus</u> sp.	14.3	1.0
Chlorophyta	57.1	
Unidentified animal material	100.0	

*Frequency is the percent of the stomachs examined containing the item listed.

**Average number of items found in stomachs which contained that item.

collected in Glover Creek by Jones et al. (1983), 137 were measured for total length. Total lengths ranged from 45 to 92 mm (TL), with a mean and standard deviation of 70.2 and 9.0, respectively (Figure 3). The individuals measuring 92 mm (TL) were **the** largest known leopard darters collected. In addition, scales were removed from 14 specimens in the Oklahoma State University Museum for age determinations. Leopard darters 53 to 74 mm (TL) were 1 year old and those 74 to 80 mm were 2 years old. After comparing age determinations with the length frequency distribution, Jones et al. (1983) assigned ages to the following groups: ≥ 50 mm, 0; 51 to 71 mm, I; 72 to 87 mm, II; ≥ 88 mm, III.

Reproductive Ecology--Nothing is known of the reproductive behavior or spawning habitat of the leopard darter. However, Jones et al. (1984) hypothesized that leopard darters probably spawn in riffles during the spring. This hypothesis is supported by the increased incidence of capture in riffles during the spring.

Sexing of the leopard darter can be accomplished by examining the modified (enlarged) midventral scales. Only males have these enlarged midventral scales on the breast and in an incomplete row on the **midbelly** (Robison 1978). Since the scales are permanent, sexing **can** be done during any season. Of **the** 88 specimens examined by Robison (1978), 45 were males and 43 were females. These values give a sex ratio of approximately **1:1**.

TOTAL LENGTH (mm)

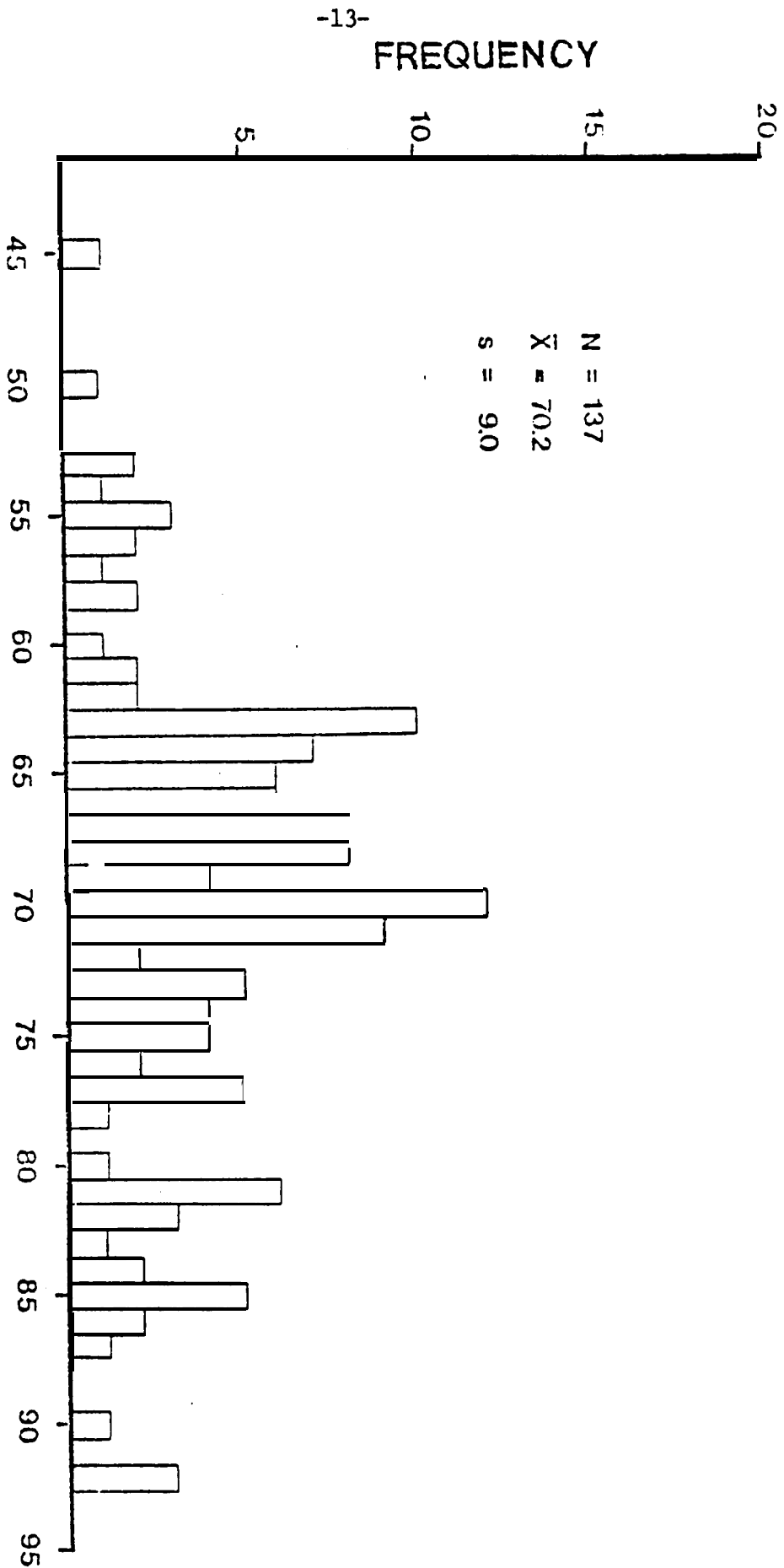


Fig. 3. Length frequency distribution of Leopard darters collected in Glover Creek from August 1977 to July 1980 (Jones et al., 1983).

The only available data on fecundity are those of Robison (1978) who examined 7 specimens. Number of mature ova ranged from 260 to 418, with **immature** ova from 510 to 2302.

Early Life History--Very few young leopard darters have been collected and essentially nothing is known of early life history,

Diseases and Parasites--There are no data on the diseases or parasites of the leopard darter (Robison 1978).

Species Associations--The leopard darter has been collected with a wide variety of fishes. Darter species with which the leopard darter is most commonly associated are Percina caprodes, P. copelandi, and Etheostoma radiosum. Other darters occasionally collected with the leopard darter include P. sciera, P. phoxocephala, E. spectabile, E. nigrum, E. asprigene, and E. gracile (Robison 1978, Jones et al. 1983).

No definitive data are available on predators of the leopard darter.

However, potential predators include: Esox americanus, Lepomis cyanellus, M. macrochirus, L. megalotis, Micropterus salmoides, M. punctulatus, M. dolomieu, and Ictalurus punctatus (Robison 1978).

Major Threats

The endemic distribution and **naturally** low abundance of this species dictate that any major impact on the Little River system potentially threatens the continued survival of leopard darters. Several such threats

presently occur in the Little River. As the area develops economically, pressures on the leopard darter and its habitat are expected to increase.

Impoundments-- Presently, impoundments pose the greatest threat to the leopard darter through inundation of habitat and alterations in the quantity and quality of downstream flows (Eley et al. 1975, Hubbs and Pigg 1976). Many reservoirs impound the Little River system: Pine Creek Reservoir on the upper Little River, Broken Bow Lake on the Mountain Fork River, **DeQueen** Reservoir on the Rolling Fork River, **Gillham** Reservoir on the Cossatot River, Dierks Reservoir on the Saline River, and **Millwood** Reservoir on the **lower** Little River. With the exception of **Millwood** Reservoir in Howard and Little River Counties, which is too far downstream to affect leopard darter habitat, all these **impoundments** are considered threats to the leopard darter (Robison 1978). **Only** 3 leopard darters are known to have been collected below reservoirs: 2 below **Gillham** Reservoir and 1 below Pine Creek Reservoir (Robison 1978, O. E. Maughan pers. comm.).

Very little can be done about the impact of present impoundments and increased demands for water for agricultural and municipal uses, and planned flood control structures may force further reservoir construction (Oklahoma Comprehensive Water Plan 1980). Of the proposed reservoirs, Lukfata Lake, which is authorized but not funded, on Glover Creek would have the greatest impact on leopard darters by threatening the largest known leopard darter populations.

Silviculture--Silviculture, a major economic activity in the Little River basin, and associated road construction, currently cause many alterations within the watershed. Potential impacts **from** road construction (Chutter 1969, **Bartan** 1977, Murphy and Hall 1981) and removal of stream side vegetation (Burns 1972, Kopperdahl et al. 1971) include increased turbidity and sedimentation in streams. These activities threaten the leopard darter through habitat degradation and altered water quality.

Agriculture and Industry--As a result of agriculture and industry, the incidence of fish kills in the Little River is increasing (Robison 1978). For example, one fish kill involved the flushing of creosote from a **lumber** treatment waste pond into the Cossatot River and affected 10 miles of **stream**. As agriculture and industry **continue** to develop, the potential threat to the leopard darter from water quality degradation increases.

Gravel Removal Operations--Several gravel removal operations in the Little River drainage threaten local leopard darter populations through habitat **destruction** and water quality degradation (Robison 1978).

Conservation Efforts

Conservation efforts have consisted primarily of research funded by the U.S. Fish and Wildlife Service to obtain baseline information on the **status** of leopard darters and to collect data on life history and ecology. Research has been concentrated on populations in Glover Creek (Jones et al. 1983) and the Cossatot River by Robison (Jones et al. 1979).

PART 11 - RECOVERY'

Action Plan

Major Objective--The major objective of the recovery **plan** is to describe those actions which, if implemented, will assure the continued existence and survival of the leopard darter in a **non-threatened** status.

STEP-DOWN OUTLINE

1.0 Identification of important habitat.

1.1 Important habitat presently identified.

1.11 Areas presently designated **as critical** habitat.

1.12 Upper West Fork of Glover Creek.

1.2 Procedures for identifying additional important habitat.

1.21 Areas recommended for inventory.

1.211 Main channel of **Little** River.

1.212 Watson Creek tributary to Little River.

1.213 Honobia Creek, tributary to Little River.

1.214 Blackfork Creek, tributary to Little River.

1.215 Main channel of Glover Creek.

1.216 Cedar Creek, tributary to Glover Creek.

1.217 Carter Creek, tributary to Glover Creek.

1.218 Pine Creek, tributary to Glover Creek.

1.219 West Fork of **Glover Creek**.

1.2110 East Fork of Glover Creek.

1.2111 Big Eagle Creek, tributary to Mountain Fork River.

1.2112 Botukolo Creek, tributary to Mountain Fork River.

1.2113 Cucumber Creek, tributary to Big Eagle Creek.

1.2114 Six Mile Creek, tributary to Big Eagle Creek.

1.2115 Cow Creek, tributary to Mountain Fork River.

1.2116 Cossatot River.

1.2117 Rolling Rork River.

1.2118 Saline River.

1.2119 Little River

1.2120 Mountain Fork River.

1.2121 **Cossatot River.**

1.22 Sampling procedures and schedules.

1.221 Methods **and** techniques.

1.222 Schedules.

1.223 Data.

1.23 Selection of personnel.

1.24 Evaluation of data.

2.0 Research of unknown life history aspects.

2.1 Reproductive ecology.

2.2 Early life history.

2.3 Habitat.

3.0 Habitat management and protection.

3.1 Area of operation.

3.2 Management agreements.

3.21 Private landholdings.

3.22 State and Federal landholdings.

3.3 Monitor leopard darter populations and habitat.

3.31 Selection of monitoring stations.

3.32 **Establishment** of field procedures.

3.33 Supplemental monitoring procedures.

3.34 Establish local watch committee.

3.35 Evaluation of field data and procedures.

3.36 Evaluation of supplemental information.

3.4 Habitat protection.

3.41 Enforce State and Federal water quality standards.

3.42 Monitor appropriate **State** and Federal agencies.

3.421 Contact agencies and list projects.

3.422 **Interagency notification.**

3.43 Develop process for quick response.

4.0 Information and **education.**

NARRATIVE

Objective

The leopard darter can be **removed** from the Federal list of threatened and endangered species only when **all** the important areas of leopard darter habitat have been identified, are no **longer** threatened by adverse modification, and the continued existence of the species in its habitat is assured. The area presently designated as critical habitat for the leopard darter in the Little River has already been identified as important and must continue to be protected. Also, efforts will need to be expended to ensure that additional areas of important leopard darter habitat are identified and protected. Little or nothing is known about major aspects of leopard darter life history, e.g., reproductive ecology and early life history. Research should be conducted to obtain these data in order to ensure that habitat protection and management strategies are designed to meet the leopard darter's specific ecological requirements. Until research on life history and habitat requirements has been conducted on the leopard darter, quantifiable goals with respect to population numbers cannot be set.

1.0 Identification of important habitat.

The leopard darter occurs only in the upper reaches of the Little River and its major tributaries. Throughout its distribution, leopard **dar**ter abundance is very low and the species probably was

never abundant. Therefore, it is imperative that all the areas of important leopard darter habitat be identified for subsequent protection and management under the auspices of the recovery process. Some areas already have been identified and are presented in Sections 1.11 and 1.12. Other areas need to be evaluated, as part of the recovery **process**, and are listed in Section 1.2.

1.1 Important habitat presently identified.

Several areas throughout the Little River already have been identified as important leopard darter habitat and need not be further evaluated through the recovery process.

1.11 Areas presently designated as critical habitat.

Designated critical habitat obviously is important to leopard darter recovery and does not need further evaluation.

1.12 Upper West Fork of Glover Creek.

This area was identified by Jones et al. (1983) as one of the most productive locations in the Glover Creek system for leopard darters. That portion of the main channel, from the community of Battiest, Oklahoma, upstream to the point where the channel enters Section 24, **R22E, T1S,**

should be recognized as important habitat based upon Its production of leopard darters.

1.2 Procedures for identifying additional important habitat.

A number of areas throughout the Little River represent potentially productive habitat for leopard darters. However, available data and information on leopard darters in these areas are either insufficient or non-existent for an objective determination to be made. Therefore, an inventory of leopard darter populations in these areas must be conducted, as part of ~~the~~ recovery process, in order to obtain the required data. Specific areas that **should** be inventoried are listed in 1.21. Procedures, methods, data, and schedules that should be followed are listed in Section 1.22.

Qualifications of personnel conducting the inventory are recommended in Section 1.23. Criteria to be used for evaluating data and making final determinations are discussed in Section 1.24.

1.21 Areas recommended for inventory.

The areas described below are typically main stream sections of major rivers and their principal tributaries. Some

of these **areas**, or portions thereof, are relatively inaccessible. When possible, specific locations where sampling sites could be established are listed. The **number** of sampling sites to be established in each area will depend primarily on budgetary constraints. However, recommendations will be given as to the minimum **number** of sites that should be established in each area.

1.211 Main channel of Little River.

From the **Pushmataha-LeFlore** County line upstream to where the stream enters Section 1, **R23E, T1N**. Sampling sites could be located in Sections 11, 13, 22, and 23, **R23E, T1N**. At least 3 sites should be sampled.

1.212 Watson Creek, tributary to **Little** River.

From its mouth upstream to where it enters Section 25, **R21E, T1S**. Sampling sites could be established in Sections 19, 24, and 26, **R21E, T1S**. At least 2 sites should be sampled.

1.213 Honobia Creek. tributary to the Little River.

From its mouth upstream to where it enters Section 35, **R22E, T1N.** Sampling sites could be established in Sections 2 and 3, **R22E, T1N,** and in Section 19, **R23E, T1N.** At least 2 sites should be sampled.

1.214 Blackfork Creek, tributary to the Little River.

From where the stream crosses Highway 144 upstream to where **it** enters Section 19, **R20E, T1N.** Sampling sites could be established in Sections 18 and 31, **R20E, T1N,** and in Section 6, **R20E, T1S.** At least 2 sites should be sampled.

1.215 Main channel of Glover Creek.

From its mouth upstream to where it is crossed by Highway 7. Sampling sites could be located **in** Sections 28 and 33, **R23E, T5S,** and in Sections 5, 7, 8, and 18, **R23E, T6S.** At least 3 sites should be sampled.

1.216 Cedar Creek, tributary to Glover Creek.

From its mouth upstream to where it crosses Highway 259. Sites could be located in Sections 22, **25,27**, 28, and 29, **R23E, T4S**, and in Sections 18 and 20, **R24E, T4S**. At least 3 **sites should be** sampled.

1.217 Carter Creek, tributary to Glover Creek.

From its mouth upstream to where it crosses Highway 259. Sites could k established in Sections 34, **35, and 36, R23E, T3S**, and in **Section 3, R23E, T4S**. At least 2 sites should k established.

1.218 Pine Creek, tributary to Glover Creek.

From its mouth, upstream to where it enters Section 1, **R23E, T3S**. Sites could be established in Sections 10, 11, and 12, **R23E, T3S**. At least 2 sites should k established.

1.219 West Fork of Glover Creek.

Main channel from where it enters Section 24, **R22E, T1S**, upstream to the **McCurtain-LeFlore** County line.

Sites could be established in Sections 2, 11, and 14, **R22E, T1S**. At least 2 sites should be established.

1.2110 East fork of Glover Creek

Main channel from the boundary of designated critical habitat (approximately where it enters Section 32, **R24E, T1S**) upstream to where it enters Section **13, R23E, T1S**. Sites could k established in Sections 18 and **33, R24E, T1S**. At least 2 sites should k sampled.

1.2111 Big Eagle Creek, tributary to Mountain Fork River.

From its mouth upstream to where it enters Section 6, **R25E, T1N**. Sites could be established in Sections 4, 9, 22, and 23, **R25E, T1S**, and in Sections 7, 17, and 20, **R25E, T1N**. At least 3 stations should be established.

1.2112 Boktukolo Creek, tributary to Mountain Fork River.

From its mouth upstream to where it enters Section 35, **R24E, T1N**. Sites could k established in Sections 2, 11, 12, and 13, **R24E, T2S**. At least 2 sites should be established.

1.2113 Cucumber Creek, tributary to Big Eagle Creek.

From its mouth upstream to where it enters Section 5,
R26E, T1N. Sites could k established in Sections 7
and 8, **R25E, T1N.** At least 2 sites should be established.

1.2114 Six Mile Creek, tributary to Big Eagle Creek.

From its mouth upstream to where it enters Section 30,
R31W, T3S, in Arkansas. Sites could k established in
Section 17, **R27E, T1N** (Oklahoma) and in Sections 29,
26, 34, and 35, **R32W, T3S** (Arkansas). At least 3 sites
should be established.

1.2115 Cow Creek, tributary to Mountain Fork River.

From its mouth upstream to where it enters Section 18,
R27E, T1N. Sites could k established in Sections 18,
30, 31, and 32, **R27E, T1N.** At least 2 sites should
be established.

1.2116 Cossatot River.

Main channel from Highway 4 crossing upstream to
a point above Highway 246 crossing (**H. W. Robison,**
pers. **comm.**). At least 4 sites should be established.

1.2117 Rolling Fork River.

Main channel from end of slack water of **DeQueen** Reservoir upstream to a point near Wicks, Arkansas (H. W. Robison, pers. **comm.**). At least 3 stations should be established.

1.2118 Saline River.

Main channel **from** the end of slack water of Dierks Reservoir upstream to Highway 84 crossing, near Athens, Arkansas (H. W. Robison, pers. **comm.**). At least 3 stations should be established.

1.2119 Little River.

Main channel from the outlet of Pine Creek Reservoir downstream to where it crosses Highway 98 near Wright City, Oklahoma. Sites could be established in Sections 6 and 8, **R22E, T6S**. Most of this area is **unaccessible** by road. Consideration should be given to floating down the area in boats and rafts. At least 3 sites should be established.

1.2120 Mountain Fork River.

Main channel from Broken Bow Dam downstream to where it crosses U.S. Highway 70. Sites could be established in Sections 3, 4, 9, and 14, **R25E, T5S**, in Section 31, **R26E, T5S**, and in Section 7, **R26E, T6S**. A major section of this area is **unaccessible** by road and consideration should be given to floating the area with boats or rafts. At least 3 stations should be established.

1.2121 Cossatot River.

The main channel from **Gillham** Dam downstream to Highway 24 crossing (H. W. Robison, pers. **comm.**). At least 3 stations should be established..

1.22 Sampling procedures and schedules.

Based on previous work (Jones et al. **1983**), many of the techniques and methods for successfully collecting and/or observing leopard darters and the problems encountered during sampling have been evaluated.

1.221 Methods and techniques.

After the total number of stations to k established in each area listed in Section 1.21 is determined, the stations should k distributed as uniformly as possible throughout the area. These stations should be permanent and should k used throughout **the** duration of the inventory for that area. The upstream and downstream **boundaries** at each sampling station should be marked for easy location and orientation. The area within the sampling station should include as many different types of habitat as possible, i.e., riffles, runs, pools, etc., so as to avoid disproportionate sampling of habitat types. The total length of the sampling site should not be less than 100 m, in most cases, although in larger streams, a shorter area may be required to accommodate the additional width. Snorkeling and D.C. pulse electrofishing are **the** most efficient methods for collection and/or observation but should be restricted to areas less **than** 100 cm deep. Seines are not recommended because of difficulty in sampling over larger substrates. For areas greater than 100 cm deep, snorkeling and D.C. pulse **electro-**fishing **become** increasingly inefficient and scuba

may be required . Sampling effort must be uniform between stations to ensure that data are comparable. A predetermined amount of time (at least 1 hour) and/or amount of area (100 m stream) should be established and used at every station.

1.222 Schedules.

Because of high. water levels, unpredictable variations in flow, and resulting high turbidities during some' seasons, it is recommended that sampling k conducted during the low flow periods of early summer to fall (June to October). Jones et al. (1983) found that leopard darter populations in Grover Creek fluctuated quite widely at a **number** of stations, both seasonally and annually. Therefore, to ensure that **the** inventory has every opportunity to account for possible fluctuations in population numbers, the inventory should k conducted for at least 2 consecutive years, with each station king sampled at least twice during each year.

1.223 Data.

Primarily, the purpose of the inventory is to obtain data on the distribution and abundance of leopard darters in each area of interest. However, opportunities for collecting other data should be realized when appropriate. When possible, captured leopard darters should be measured for total length and ~~their~~ sex determined. Approximate numbers of other fish species present should be recorded and habitat availability estimated. Other types of data to be considered are discussed more fully in Section 2.3. Although every effort should be made to return captured leopard darters unharmed to the water as soon as possible, mortalities ~~will~~ inevitably occur. These specimens should ~~be~~ preserved carefully for museum collections.

i.23 Selection of personnel

Careful consideration ~~should~~ be given to selection of personnel conducting the field operations and research. Personnel should be familiar with the leopard darter, its habitat, the ~~sampling~~ gear and techniques to be used,

and the areas of operation. The ability to positively identify the leopard darter in the field is mandatory. Although distinctly different, smaller leopard darters may be confused with either channel darters (Percina copelandi) or dusky darters (P. sciera), if not examined carefully.

1.24 Evaluation of data.

The data collected on Leopard darter abundance during the inventory will provide the basis for making the determination ~~whether~~ the areas inventoried, as listed in Section 1.21, should be designated as important leopard darter habitat. Jones et al. (1983) estimated that the average densities (numbers/100 m stream) of leopard darters in Glover Creek and the Cossatot River were 3.64 and 3.44, respectively. Both of these streams are considered as areas of high quality leopard darter habitat. Therefore, it is recommended that those areas listed in Section 1.21 which have an average density \geq 4 leopard darters/100 m stream (or equivalent) be designated as important leopard darter habitat. Average density is taken to be the mean density of all estimates made at each sampling station in the area inventoried.

2.0 Research of unknown life history aspects.

Several aspects of ~~the~~ leopard darter's life history are unknown or poorly understood. Research will need to ~~be~~ designed and implemented to collect sufficient data on these aspects. Until as much as possible is known about the leopard darter, management strategies and decisions cannot incorporate all the specific requirements of the species.

2.1 Reproductive ecology.

Nothing is known about ~~the~~ reproductive ecology of ~~the~~ leopard darter. Since population maintenance is dependent upon successful reproduction, this aspect of ~~the~~ leopard darter's life history needs to be researched fully. This particular activity should receive a high priority during the recovery process. Data collected by Jones et al. (1983) suggest that leopard darters spawn in riffles during the spring. Research should be conducted to test this hypothesis. Data should be collected on spawning, season, length of spawning season, specific characteristics of spawning habitat, ~~pre-~~ and post-reproductive and nesting behaviors of adults, age at reproductive maturation, length of incubation and time of egg hatching. Although research has ~~been~~ proposed to obtain these data (Maughan and Jones 1982), field research in this area would require large expenditures of resources and effort. The low abundance of leopard darters would appear to

limit opportunities for field research. Consideration should be given to capturing and rearing leopard darters in the laboratory and observing spawning behavior under controlled conditions.

2.2 Early life history.

Nothing is known of the leopard darter's early life history and very few specimens less than 1 year old have been collected. Research should be conducted to obtain data on the habits (demersal, pelagic) and the preferred habitats of larval and juvenile leopard darters. However, due to the low abundance of leopard darters, opportunities for field research would be limited. Consideration should be given to observing these life history aspects in the laboratory. This section would mesh quite conveniently with Section 2.1.

2.3 Habitat.

Habitat of adult leopard darters has been described fairly well. Preferred depths, water velocities, and substrate types have been quantified. However, data by Jones et al. (1983) and information from H. W. Robison (pers. comm.) suggest that preferred habitat may vary seasonally. Additional research should be conducted to obtain sufficient data to evaluate this hypothesis.

thesis. In addition, other chemical/physical parameters also should be described. Actual water quality data at specific capture locations are limited. Data on water temperature, **dis** solved oxygen, specific conductance, turbidity, nutrients, and other water quality parameters should be collected. Abundance of leopard darters should be correlated with these data to determine specific leopard darter habitat requirements. Several aspects of this section could easily be incorporated into efforts discussed in Section 1.223.

3.0 Habitat management and protection.

Maintenance and enhancement of leopard darter populations is dependent upon adequate protection and management of the habitat. If the leopard darter is to be removed from the Federal list of threatened and endangered species, then an alternative program which provides adequate protection and management of the habitat must be in place to assume responsibility. This section outlines the major steps that should be taken toward developing such a program.

3.1 Area of operation.

The area of operation will include all the areas of important leopard darter habitat identified by the recovery process discussed in Section 1.0. This **is** to include the areas already

identified as important, in Section 1.1, and the additional areas identified as important through the inventory process, in Section 1.2.

3.2 Management agreements.

A number of private landowners and State and Federal agencies have jurisdiction and management responsibility within the Little River. To assure that management of land holdings adjacent to streams within the area of operation is adequate and consistent, this authority should be consolidated under the auspices of the recovery process to the greatest extent possible. Outlined below are several steps that should be taken to accomplish this goal.

3.21 Private landholdings.

Most of the landholdings in the Little River system are privately owned. A listing of all private landholdings and water rights adjacent to streams within the area of operation should be completed.

Wherever possible and desirable, every effort should be made to enter into cooperative management agreements with the landowner. A conveyance of easement form should

be drafted for this purpose designed specifically with the leopard darter in mind. Where cooperative **agreements** are not possible, efforts should be made to transfer these private landholdings and water rights over to public ownership for management under the recovery process.

3.22 State and Federal landholdings.

State and Federal landholdings adjacent to **streams** within the area of operation should be listed and appropriate actions made **to** inform these agencies of the leopard darter's status and recovery efforts being made. Efforts should also be made to ensure that these agencies incorporate consideration for the leopard darter into their respective **management** plans to the greatest extent possible. Production of a Land Protection Plan should be considered.

3.3 Monitor leopard darter populations and habitat.

One of the most important activities in properly protecting and managing leopard darters and their habitat will be periodic monitoring of leopard darter populations and habitat. This should be done at least once every 2 years and preferably once a year. This information is critical for ascertaining changes in population abundance and habitat quality such that

management strategy and **decisions** can be evaluated and appropriate actions taken if necessary. This section outlines how such a monitoring program should be structured and the procedures and techniques that should be employed.

3.31 Selection of monitoring stations.

Stations used for monitoring should be permanent so that data from the same area can be compared year to year with consistency. Also, these stations should be strategically located so that all major areas of important habitat are monitored. One station should be established in each of the following areas:

3.311 Main channel of Little River from the mouth of Cloudy Creek upstream to the mouth of Blackfork Creek.

3.312 Main channel of the Little River from the mouth of Blackfork Creek **upstream** to the **Pushmataha-LeFlore** County line.

3.313 Blackfork Creek from its mouth upstream to where it crosses Highway 144.

3.314 Main channel of Glover Creek from where it crosses Highway 7 upstream to the mouth of Carter Creek.

3.315 Main channel of Glover Creek from the mouth of Carter Creek upstream to the confluence of the East and West forks.

3.316 West Fork of Glover Creek from the confluence of the East and West Forks upstream to the community of Battiest, Oklahoma.

3.317 West Fork of Glover Creek from the community of Battiest, Oklahoma, upstream to where it enters Section 24, **R22E, T1S.**

3.318 East Fork of Glover Creek from the confluence of the East and West Forks upstream to where it enters Section 32, **R24E, T1S.**

3.319 Main channel of Mountain Fork River from the mouth of Boktukolo Creek upstream to the **community** of Smithville, Oklahoma.

3.3110 Main channel of Mountain Fork River from the community of Smithville, Oklahoma, upstream to **the** Oklahoma-Arkansas State line.

3.3111 Main channel of Mountain Fork River from the Oklahoma-Arkansas State line upstream to **the** community of Mountain Fork, Arkansas.

In accordance with the recovery process as described in Section 1.2, one station should be established in each area identified as important leopard darter habitat. That station should be one of the stations used during the inventory process of that area.

3.32 Establishment of field procedures.

Methods and techniques, equipment, etc., as outlined in Section 1.221 are recommended. This will provide **uniformity** and comparability of data with data collected during the initial inventory. Sampling should be conducted during the seasons **recommended** in Section 1.222. Data to be collected, especially water quality parameters and recommendations of personnel, are outlined in Sections 1.223 and 1.23, respectively.

3.33 Supplemental monitoring procedures.

In addition to intensive field monitoring of leopard darter populations and habitat, supplemental monitoring of the area of operation on a broader scope should be conducted. Consideration should be given to conducting flyovers of the entire area of operation at least once a year. This approach **would provide** the opportunity to monitor for gravel removal operations, excessive **clearcut-**ting in specific watersheds, obvious areas of excessive erosion and sedimentation, and similar, activities that are more easily missed or overlooked from the ground. Information concerning pesticide and herbicide use in the watersheds of leopard darter habitat should be collected, and contamination of habitat by pesticides should be monitored.

3.34 Establish local watch committee.

Consideration should be given to establishing a local watch committee to monitor activities **and** report them to appropriate personnel. Such a committee could be comprised of concerned landowners, sympathetic local citizens, or Oklahoma Department of Wildlife Conservation personnel. Illegal actions under Section 404 of the Clean Water Act

and pollution episodes are some of **the** activities that could be reported by this committee.

3.35 Evaluation of field data **and procedures.**

Data collected from the inventory (Section 1.21) and from other recent inventories, surveys, or reports (such as Jones et al. 1983) should form baseline levels of **infor-**
mation on leopard darter population abundance, habitat conditions, and water quality. Data on ecological and life history requirements (Section 2.0) should form additional criteria for evaluating population status and habitat conditions. Significant changes from these baseline levels and **critieria** detected during the monitoring **process** **should** be **immediately** investigated for confirmation and to ascertain factors responsible.

3.36 Evaluation of supplemental information.

Information on specific activities or conditions obtained through processes described in Sections 3.33 and 3.34 should be immediately followed by on-the-ground confirmation. Evaluation should be made as to the nature and extent of potential threat to leopard darters and/or their habitat.

3.6 Habitat protection.

The most important component of the recovery plan, and which should receive the highest priority, is the development of an administrative process to protect all important leopard darter habitat (Section 3.1) from any adverse modification. Without such a process in place, the means necessary for ~~ensur-~~ing adequate protection of the species would not be fully realized and potential threats to leopard darter populations and habitat would require that the species not be delisted. Some of the activities and responsibilities that should be carried out under this section are described below.

3.41 Enforce State and Federal water quality standards.

Existing State and Federal water quality standards and laws dealing with point and non-point sources of pollution should be stringently enforced. Information obtained through processes described in Sections 3.35 and 3.36 should be investigated as required. If necessary, appropriate actions should be taken to ensure compliance. Based on ecological requirements of the leopard darter, as determined in Section 2.3, appropriate actions should be taken to seek additional restrictions in State and Federal water quality standards. Steps should be taken

to become actively involved in water quality management plans involving the area of operation.

3.42 Monitor appropriate State and Federal agencies.

Various State and Federal agencies are responsible for resource development projects and activities to meet the needs of the public. However, some projects and activities may pose serious potential threats to leopard darters. Several actions that can be taken to develop a process to deal with this situation are outlined below.

3.421 Contact agencies and list projects.

Efforts should be made to contact all appropriate State and Federal agencies having management responsibility and authority in the region. A list of ongoing, authorized, or proposed projects and activities in the region should be compiled and evaluated for potential threats to the leopard darter. Upon evaluation, these agencies should be informed as to the nature and extent of potential threat to the leopard darter posed by these projects or activities. Appropriate steps should be taken to ensure these threats are avoided. For example,

Lukfata Lake is presently authorized for construction or Glover Creek and poses a serious threat to the leopard darter. Any impoundment that would adversely modify important leopard darter habitat, including the Lukfata Lake project, would be contrary to the recovery process. It is recommended that until Lukfata Lake is no longer authorized, and this recovery plan is completely in place, the leopard darter not be **delisted** to non-threatened status.

3.422 Interagency notification.

Appropriate steps should be taken to inform all State and Federal agencies, as listed in Section 3.421, as to the status of the leopard darter and the recovery efforts being **made**. Arrangements should be made to ensure that personnel responsible for recovery are notified immediately by these agencies as new projects or activities are proposed.

3.43 Develop process for quick response.

Steps should be taken to develop a process whereby information can be evaluated and acted upon quickly. For

example, information obtained on activities having potential threats to leopard darters, as described in Section 3.34, should be followed up as soon as possible and appropriate actions taken promptly. This process would also be responsible for acting on information from Sections 3.32 and 3.33. For example, in cases such as the creosote episode on the Cossatot River (see major threats in introduction), quick response is essential to ensure damage is minimized and future incidents are prevented.

4.0 Information and education.

Information on the leopard darter should be compiled into a comprehensive education package. Description of the leopard darter, its ecology, distribution, a map of the area of habitat and recovery efforts, and its value as part of our natural resource heritage should be emphasized. The package can be made available to appropriate and interested parties.

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PART III

IMPLEMENTATION **SCHEDULE**

The table that follows is a summary of scheduled actions and costs for the leopard darter recovery program. It is a guide to meet the objectives of the Leopard Darter Recovery Plan, as elaborated upon in Part II, Recovery. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible for these tasks, a timetable for accomplishing them, and their estimated costs. Implementing Part III is the action of ~~the~~ recovery plan that, when accomplished, will satisfy the prime objective.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (Research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information.

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and Education
2. Law enforcement
3. Regulations
4. Administration

Task Priority

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions *necessary* to provide for full recovery of the species.

PART III - IMPLEMENTATION SCHEDULE

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS (9)
					FWS		OTHER (7)				
					REGION (6)	PROGRAM (6a)		FY85 (8)	FY86	FY87	
12	Important habitat previously identified	1.1	1	0	2	Igmt		\$ 0	\$ 0	\$ 0	Already done, including 1.11 and 1.12
11	Areas recommended for Inventory	1.21	3	4	2	Igmt	ODWD AG&F CE	20,000	20,000	20,000	Includes all subtasks under task 1.21, but is a single action i.e., inventory
11	Sampling procedures and schedules	1.22	3	4	2	Igmt	ODWC CE AG&F	\$ 0	\$ 0	\$ 0	includes all subtasks under task 1.21 and is part of the inventory des- cribed in 1.21
11	Selection of personnel	1.23	3	1	2	Igmt		\$ 0	\$ 0	\$ 0	part of 1.21
11	Evaluation of data	1.24	3	4	2	Igmt	ODWC AG&F CE	10,000	10,000	10,000	evaluation should be based on data collected in 1.21
13	Reproduction ecology	2.1	3	3	2	Igmt	ODWC AG&F CE	8,000	8,000	3,000	

PART III - IMPLEMENTATION SCHEDULE

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS (9)
					FWS		OTHER (7)				
					REGION (6)	PROGRAM (6a)		FY85 (8)	FY86	FY87	
I3	Early life history	2.2	3	3	2	Mgmt	ODWC AG&F CE	5,000	5,000	5,000	should be done concurrently with 2.1
I3	Habitat	2.3	3	3	2	Mgmt	ODWC AG&F CE	12,000	12,000	12,000	should be done concurrently with 2.1 & 2.2
A3	Area of operation	3.1	3	4	2	Mgmt	ODWC AG&F CE	10,000	10,000	10,000	should be done concurrently with 1.24
A3	Management agreements	3.2	3	4	2	Mgmt	ODWC AGCF CE				
A3	Private landholdings	3.21	3	4	2	Mgmt	ODWC AG&F CE	50,000	50,000	50,000	part of 3.2 and should be coordinated with 3.22
M3	State and Federal landholdings; Land Protection Plan	3.22	3	4	2	Mgmt	ODWC AG&F CE	10,000	10,000	10,000	should be coordinated with 3.21
I1	Monitor leopard darter populations and habitat	3.3	3	ongoing	2	Mgmt	ODWC AG&F CE	2,000	\$ 0	2,000	should be done every other year and in- clude monitor- ing sites list- ed under 3.31

PART III - IMPLEMENTATION SCHEDULE

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS (9)
					FWS	OTHER		FY85 (8)	FY86	FY87	
					REGION (6)	PROGRAM (6a)	(7)				
I2	Supplemental monitoring procedures	3.33	3	ongoing	2	Mgmt	ODWC AG&F CE	2,000	2,000	2,000	part of Section 7 consultation process for Federal agencies
I14	Establish local watch committee	3.34	3	ongoing	2	Mgmt	ODWC AG&F CE	5,000	1,000	1,000	
02	Enforce State and Federal water quality standards	3.41	3	ongoing	2	LE Mgmt	ODWC AG&F	5,000	5,000	5,000	
03	Monitor appropriate State and Federal agencies	3.42	3	ongoing	2	Mgmt	ODWC AF&F CE	5,000	5,000	5,000	
M7	Develop process for quick response	3.43	3	ongoing	2	Mgmt	ODWC AG&F	5,000	5,000	5,000	
01	Information and education	4.0	3	ongoing	2	Mgmt	ODWC AG&F	2,000	2,000	2,000	could be organized similarly to recovery teams

APPENDIX

COMMENTS AND RESPONSES

The following **comments were** received from reviewers of the technical and agency review draft of the Leopard Darter Recovery Plan and are listed alphanumerically, e.g., A1, A2, etc. Responses to comments are also listed alphanumerically in the **same** sequence as comments.

- A-1 - Done.
- A-2 - Appropriate rewording was incorporated into the plan.
- A-3 - Appropriate rewording was incorporated into the plan.
- A-4 - Information noted.
- A-5 - Done.
- A-6 - Changes made in citations.
- A-7 - Suggestion noted.
- A-8 - Suggestion noted.
- A-9 - Suggestion noted.
- A-10 - Done. Some changes made. Major habitat protection tasks must await data on environmental needs. Expect more detailed direction in the first update of the plan.
- A-11 - Added as one of the recovery tasks.
- A-12 - Done.
- A-13 - Added as one of the recovery tasks.
- A-14 - Added as one of the recovery tasks.
- A-15 - Done.
- A-16 - Done.
- A-17 - These agencies are included in Part III.
- A-18 - Done.
- A-19 - Agree; suggestions added.
- A-20 - The objective was reworded, but due to unknown needs cannot be quantified at this time.
- A-21 - Done.
- A-22 - This information will be obtained as part of other **information-**gathering projects.
- 4-23 - A **captive** population is not warranted at this time due to the widespread distribution of the species. Study of the **reproductive** biology of the leopard darter is a recovery task (2.1).
- A-24 - Include in Part II.
- A-25 - Include in Part II.
- A-26 - Suggestion incorporated into plan.
- A-27 - Done.
- A-28 - Done.
- A-29 - Noted.
- A-30 - Incorporated.
- A-31' - Agree; information incorporated.
- A-32 - Done.
- A-33 - Done.

A-34 - Done.
A-35 - Done.
A-36 - Done.
A-37 - Done.
A-38 - Clarified.
A-39 - Done.
A-40 - Done.
A-41 - **Added.**
A-42 - Changed.
A-43 - Done.
A-44 - Agree.
A-45 - Done.
A-46 - Done.
A-47 - Done.

THE UNIVERSITY OF TEXAS AT AUSTIN
DEPARTMENT OF ZOOLOGY



December 22, 1983

End. Sp. R42
JOHNSON
Bowman
Carley
Halvorson
Hoffman
Kalogiski
Largowski
KAYSER
Hopp
Padilla
SANCHEZ
FILE / signed / date

James E. Johnson
Department of the Interior
Fish and Wildlife Service
P.O. Box 1306
Albuquerque, N.M. 87103

Dear Jim:

I have reviewed the technical draft of the leopard darter recovery plan and have several trivial to consequential comments.

A-1 P. 4, lines 9 & 12, also P. 9, line 14. These personal communicants should be identified by initials.

A-2 P. 4, bottom 3 lines. The statement that the leopard darter is the second most abundant species obscures the fact that it is a distant second - Etheostoma radiosum is nearly 70 times as abundant. Moreover there may be a faulty assumption in the data base. Presumably, the 14 stations were established at places where leopard darters occur in Glover Creek. Thus, stations unlikely to contain leopard darters would have minimal to no sampling. Any darter in those locations would in turn be less extensively represented. For example, the 5± mile reach downstream from Highway 7 presumably has few leopard darters and is likely to have the other 3 species of Percina. Although not present in the Jones et al. samples, other darters have been obtained from the Glover Creek (notably Etheostoma histrio).

A - 3 P. 6, first line. "occasionally" is not my favorite word for 25+% of the darters taken.

A-4 P. 7 - following the above. A reference to Stevenson's 1971 report that Percina macrolepida has a (pre) spawning migration from pools to riffles might help. That species occupies pools in summer and spawns in riffles in winter. There may be a close parallel here.

A-5 P. 8, 4th line from bottom. A closing parenthesis is missing.

cc: Gene Maughn
Ray Jones/1-6-84/vah

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DEC. 29 '83

SE

page 2
12/22/83

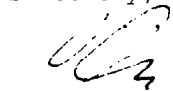
A-6 P. 11. Those senior authors are different people, (Hubbs).

A-7 P. 18. That sampling schedule would be best if it included the presumed spawning season. I bet a beer on March through May. One series must be at that season.

A-8 P. 19. If I were to consider potential confusing species, I would list Percina sciera.

A-9 P. 20. I would suggest that small darters (including leopard darters) would be found at the shallow stream edges.

Sincerely,

A handwritten signature in dark ink, appearing to be 'Clark Hubbs', written over a horizontal line.

Clark Hubbs

CH/pm

UNITED STATES GOVERNMENT

U.S. FISH & WILDLIFE SERVICE

Memorandum

DRD
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2 FILE SE

TO : Regional Director, FWS, Albuquerque, NM (AHR)(AFA) DATE: January 24, 1984
Attn: James E. Johnson (SE)

FROM : Field Supervisor, ES, Tulsa, Oklahoma

SUBJECT: Leopard Darter Technical Review Draft Recovery Plan

Members of my staff and I have reviewed the subject draft plan as requested by Dr. Johnson in his memorandum of December 5, 1983, paying particular attention to technical accuracy and completeness.

Wilkirson was well-satisfied with the draft. While he considers himself ignorant about matters such as recovery plans, he saw no inaccuracies and he was impressed with the thoroughness of the actions proposed. Wilkirson recalls from several past studies on the Lukfata Lake Project that an all too frequently unanswered question was "why do leopard darters seem to disappear downstream from reservoirs?" Wilkirson believes there is sufficient action proposed in the subject plan to cover this question.

Bob Short thought the draft appeared thorough and well done. Suggested actions seem appropriate. Something missing in last sentence of Part 1.23.

Charles Scott's comments are as follows:

I also must plead ignorance when it comes to recovery plans. I suppose that this technical review draft is a "first cut" for several upcoming versions before the plan is finalized. The document has some excellent background information and future information needs. I personally believe this draft plan could use some improvement on the "operational aspects" of the plan to recover the leopard darter. In other words, those actions that are needed to protect and enhance populations and habitat that would help fulfill the objective of the plan (i.e., eventual delisting).

The recovery plan seems to be well done and covers most aspects concerning recovery efforts for the leopard darter. Part II "Recovery Action Plan" is an important part of the Recovery Plan. This section contains a good discussion of populations and life history data needs for the leopard darter. Sections 3.0 "Habitat Management" and 6.0 "Enforce Federal and State laws" constitute the guts of the "operational" objectives of the plan. Listing of landowners and projects within the critical habitat would be a worthwhile venture. However, I believe additional measures to insure protection of habitat should be addressed in the Recovery Plan. The section on Cooperative Agreements (3.23) could be expanded. Inclusion of a suggested form letter to landowners like the one contained in the draft Northern Bald Eagle

FWS REG 2
RECEIVED

FEB 1 '84

SE

REC'D
FWS-Region 2

JAN 30 1984

cc: Ray Jones
Eugene Maughan/2-7-84/vah

AFF

A-10

A-11

A-12

Recovery Plan (copy attached) or a conveyance of easement form similar to the one presented by Steenhof in the Management of Wintering Bald Eagles (copy attached) would be beneficial.

A-13

Section. 4.0 "Monitor Leopard Darter Populations and Habitat" contain an outline to monitor' the darter's population. However, little is said about "habitat" monitoring. I believe that it would be helpful to survey the leopard darter's critical habitat on a regular basis to identify potential or existing threats. One suggestion would be to conduct an annual fly-over of the critical habitat to assess changes in the stream (i.e., new gravel operations, erosion) or in the watershed (i.e., **clear-cutting**). A watch committee could be established to monitor

A-14

activities and report them to the appropriate agencies or personnel. Such a committee could be comprised of concerned land-owners, sympathetic local citizens, or Oklahoma Department of Wildlife Conservation personnel. Illegal actions under Section 404 of the Clean Water Act and pollution episodes are some examples of activities that could be reported by this committee.

A-15

I believe that water quality should receive more attention in Section 6.0 "Enforce Federal and State Laws." There are existing State and Federal laws that deal with point and **nonpoint** sources of pollution. The Recovery Plan should emphasize the need to maintain stringent enforcement of these laws and regulations and seek additional restriction as necessary. The Recovery Plan

A-16

should discuss the need to prevent or eliminate the presence of environmental contaminants within the leopard darter **habitat**. Active involvement in water quality management plans involving the darter's critical habitat should be encouraged. Agencies

A-17

response to emergency chemical spills (i.e., like the creosote episode on the Cossatot River) should be addressed in the Recovery Plan.

A-18

I am somewhat confused about the language and intent of Section 6.3 "Confer with Agencies." Does this mean efforts should be made to "consult" with agencies whose projects pose a threat to the leopard darter and/or its habitat? Sections 6.2 and 6.3 imply that the requirements of Section 7 of the Endangered Species Act will be carried out. These sections need further clarification if this is the intended purpose.

Steve Hensley's comments are as follows:

It appears that the Recovery Plan is very well done. Because of the paucity of data on the leopard darter it would be difficult

SUGGESTED FORM FOR LETTER TO PRIVATE LANDOWNERS

(Modified from letter being used in the state of Maine)

Dear []:

You are one of the few fortunate individuals in the continental United States to have a bald eagle nest on your property. As you probably are aware, the bald eagle population declined for many years. Pesticides, shooting, trapping, and other human activities all have been involved. Another important factor is the loss of nesting habitat.

We are contacting you because of this last concern. As part of a coordinated effort by the [], U. S. Fish and Wildlife Service, [and . . .], to manage bald eagles, we have developed management guidelines for every bald eagle nest known in the state.

The attached report deals specifically with the pair of eagles nesting on your property. It summarizes everything we know about the nest location, site characteristics, nearby areas used by the eagles, nesting history of the pair, and any other research data available (food habits, behavior, contaminant levels, etc.). The last section provides some guidelines to help maintain the integrity of the nest site and to maintain or improve the eagles' nesting success. We want to stress that these are only suggestions, not hard and fast rules or regulations.

Eagles exhibit a high degree of loyalty to a nest site over time. Occasionally a nest is not used for several years. This may be due to death of one or both adults, disturbance, or some other factor. Our data now indicate that these sites merit protection because eagles will return to nest in the same area, often in an old nest or rebuild in the same nest tree, after an absence of 10 or more years. Therefore, we have prepared guidelines for all nest sites which are currently suitable, even if unused for several years. We hope that these sites will be reoccupied as our eagle population recovers. Maintenance of good nesting habitat is the key to the bald eagle's future.

In addition to your help and cooperation in protecting these valuable eagle areas, we would appreciate receiving any further information, comments, questions, and ideas that you may have. We welcome reports of feeding areas, perching areas on other properties, or nearby developments which threaten the nest site. Please contact us or your local state wildlife personnel:

Regional biologist: []

Conservation officer: []

Should you decide to sell or modify the nest site or adjacent property, please notify us first. Perhaps together we can work out a solution that will maintain the area as good eagle habitat. We hope this information has been of some help and that mutually we can benefit the bald eagles.

Thank you.

Sincerely, []

APPENDIX B. CONVEYANCE OF EASEMENT FOR PROTECTION AND
ACCOMMODATION FOR MAINTENANCE OF BALD EAGLE
WINTERING HABITAT

THIS INDENTURE, Made this ____ day of _____, 19____, by and between
_____ of _____ in the County of _____,
State of _____, parties of the first part, and _____
Of _____, in the County of _____ State of _____,
party of the second part.

WITNESSETH:

WHEREAS, the land described below contains or includes habitat suitable for
use by wintering Bald Eagles.

NOW, THEREFORE, for and in consideration of the sum of
(\$ _____) the parties of the first part, do hereby grant and convey an
● easement and right in perpetuity unto the party of the second part,
for the purpose of maintaining the land described below as habitat for bald
eagles, together with the right of ingress and egress thereto, for the purpose
of inspection and maintenance by the party of the second part, its agents
and assigns, as follows:

Subject, however, to all existing rights-of-way for highways, roads, railroads,
pipelines, canals, laterals, electrical transmission lines, telegraph and
telephone lines, cable lines, and all outstanding mineral rights.

The parties of the first part, for themselves, and for their heirs, successors
and assigns, covenant and agree that they will cooperate in the maintenance
of the aforesaid lands as habitat for Bald Eagles; by not introducing practices
which will interfere with or endanger Bald Eagles, without prior approval of
the party of the second part, its agents and assigns; by not removing or
permitting the removal of grass from the above-described lands by any means;
by not constructing or placing thereon, or permitting the construction or
placements thereon of year-round residential, recreational, or commercial
structures including mobile homes, and by not granting easements for rights-
of-way without prior approval of the party of the second part, its agents
and assigns.

It is understood that this indenture imposes no other obligations or restrictions
upon the parties of the first part and that neither they nor their successors,
agents, lessees, or any other person or party claiming under them shall in
any way be restricted from carrying on farming practices such as grazing,
haycutting, plowing, working and cropping lands, and that they will utilize
all of the subject lands in the customary manner except for the provisions
mentioned above.

In witness whereof, the parties of the first part have hereunto set their
hands and seals as of the day and year above written.

_____(Seal) _____(Seal)
_____(Seal) _____(Seal)



United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

In Reply Refer To:
FWS/OES

FEB 8 1984

RD	
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FILE	Leopard darter

MEMORANDUM

To: Regional Director, Region 2 (ARD/AFF)

From: *Assistant Director*
Director

Subject: Comments on the Recovery Plan for the Leopard Darter -
Technical Draft

Attached is a copy of the subject plan with specific editorial and substantive comments indicated in the margins. A few of the more substantive comments are reiterated below:

A-20

1. Page 13, Objective: The objective should indicate the number of miles of stream that need to be protected and the relative abundance of darters that must be reached before consideration of delisting can take place. If it is unlikely that the darter can be delisted, then the delisting potential should be discussed.

We realize that quantification of objectives may be difficult or impossible at this time, but extrapolation should at least be discussed and some objective set. The recovery plan is designed to be a dynamic working document and has the flexibility to incorporate new adjusted objectives as new information on the darters becomes available.

Please rework the objective so that those factors which led to the listing of the darter are addressed. The alleviation of these factors should be included in the objective.

q-21

2. Page 22, Task 3.22: Identification of protection strategies should be accomplished through the Service's Land Protection Planning process. A task should be included for necessary habitat protection planning.

We hope these comments will prove to be useful in revising this plan. If you feel the substantive comments noted in the margins and/or included in this memorandum are not suitable for incorporation in the revision of this draft, please explain your position in a return cover memorandum. Please return five copies of the agency draft to this office for review.

Roman H. Koening

REC'D
FWS-Region 2

FWS REG 2
RECEIVED FEB 10 1984

Attachment

FEB 13 '84

AFF



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

31 JAN 1984

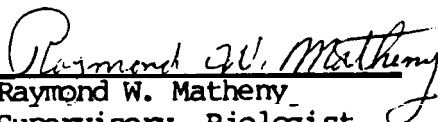
Department of the Interior
U. S. Fish and Wildlife Service
Washington, D. C. 20240

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

Attention: Larry Thomas
Office of Endangered Species

Dear Larry:

As requested, we have reviewed the draft Recovery Plan for the
Leopard Darter (*Percina pantherina*) which this Branch received on
1/3/84. We appreciate the opportunity to comment on the
merits of this document and trust that the following observations
by Michael Rexrode of our staff will contribute toward ampletion
of the final Recovery Plan.


Raymond W. Matheny
Supervisory Biologist
Ecological Effects Branch
Hazard Evaluation Division

"The Ecological Effects Branch would like to emphasize the
following issues:

A-22

1. Since sedimentation is affecting habitat, researchers should
map the distribution of base level substrates and overlying
sediments.

A-23

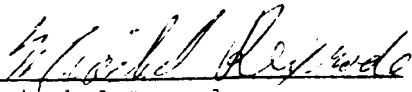
2. Maintain a captive population of darters at the proper facilities.
 - a. Research possible breeding programs as an alternative.

A-24

3. Monitor all projects that could directly or indirectly affect water
quality and ecosystem of concerned darter habitat.
 - a. Information on all pesticide usage by agricultural personnel
and home owners.

A-25

4. Life History Aspects
 - a. Sampling to determine seasonal distribution of darters as
noted in Section 1.32."


Michael Rexrode
Fisheries Biologist
EEB/HED



VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061 USA

SCHOOL OF FORESTRY AND WILDLIFE RESOURCES (703) 961-5481
Department of Fisheries and Wildlife Sciences

February 23, 1984

James E. Johnson'
Chief, Endangered Species
U. S. Fish and Wildlife Service
P. O. Box 1306
Albuquerque, NM 87103

Dear Dr. Johnson:

End. Sp. R-2
JOHNSON
Bowman
Carley
Halverson
Hoffman
Kolodinski
Lengowski
KAYSER
Hono
Padilla
SANCHEZ

FILE 40157

I have finally gotten around to reviewing the draft recovery plan for the leopard darter. I apologize for the delay but prior commitments have been overwhelming the last two months.

Overall, I thought that the draft was well written and without major flaws in information on distribution, abundance, ecology, and major threats. I totally agree with the conclusions drawn in these sections.

The leopard darter was probably always rather rare throughout its range. Consequently, the monitoring of leopard darter population abundance at historical stations (sections 1.11 and 4.1) is extremely expensive if reliable data are to be obtained. In reference to methods and techniques (see 1.21) for monitoring abundance, DC electrofishing and underwater snorkeling are both effective at depths less than 80-100 cm. In deeper areas (> 80-100 cm) snorkeling would be ineffective and use of SCUBA would be required. Thus far, little effective sampling has been conducted at depths much greater than 1 m. In this section I would also expect to see some statement that sampling at each station would be conducted for at least x minutes or until a minimum number of leopard darters were captured or observed. Previous data on catch per unit effort is of little utility when most values are zero or based on few captures.

Sampling schedules (Sec. 1.22) should be limited to low flow conditions (low turbidity and high visibility) during the recommended time frame (June to October).

Recommended research on reproductive ecology and early life history is critical to understanding what human threats are most detrimental. However, I'm afraid that many of the research objectives would be unattainable even with an extraordinary amount of sampling. It may be necessary to rear the leopard darters in the lab in order to obtain sufficient information on incubation time. Perhaps larger concentrations of spawning leopard darter could be found during future surveys; however,

Silver Anniversary Symposium

April 19-20, 1984

cc: Ray Jones
Gene Maughan
Jim Williams/3-2-84/vah

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FEB 28 '84

James E. Johnson
Page 2
February 23, 1984

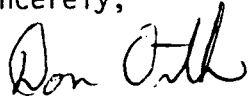
A-30

if our previous experiences are reliable, there is little opportunity to conduct field research on reproductive ecology and early life history. One aspect which seemed to be ignored was the habits (demersal, pelagic) and preferred habitats of the larval and juvenile leopard darters. These aspects could be researched through a combined lab rearing and field research program. I suspect that juvenile leopard darters commonly inhabit pools just as the adults do. Consequently, land-use practices that cause siltation (road construction, agriculture, logging) may be detrimental to the early life stages.

A-31

If you have any specific questions regarding my comments do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Don Orth".

Donald J. Orth
Assistant Professor
Fisheries Science

DJO/cwl



United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

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In Reply Refer To:
FWS/OES

JUN 4 - 1984

Memorandum

To: Regional Director, Region 2 (ARD/AFF)

From: Acting Associate
Director

Subject: Recovery Plan for the Leopard Darter - Agency Review Draft

Attached is a copy of the subject plan with editorial and substantive comments indicated in the margins. Editorial comments have been noted on pages i, 1, 2, 6, 9, 10, 13, 33, 38, and Tables 2 and 3. The more substantive comments are as follows:

- A-32 1. According to the Recovery Planning Guidelines, the plan should comply to the following format:

Title page
Disclaimer page
Table of Contents
Part I - Introduction
Part II - Recovery
 A. Objective
 B. Step-down Outline
 C. Narrative
 D. Literature Cited
Part III - Implementation Schedule
Part IV - Appendix

- A-33 2. Title page: Add "Published by the U.S. Fish and Wildlife Service, Albuquerque, New Mexico." Also add the heading "DATE" to the line below the approval line.

- A-34 3. Disclaimer page: The final draft should include the proper acknowledgement for the plan, as well as identify the Fish and Wildlife Reference Service as the source for additional copies.

- A-35 4. Page 1, Introduction: A map of critical habitat should include all place-names mentioned on pages 1 and 2.

- A-36 5. Page 2, Taxonomy: Only the first letter of the heading "Taxonomy" should be capitalized in order to be consistent with the headings on pages 3 and 5.

FWS RE
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JUN 8

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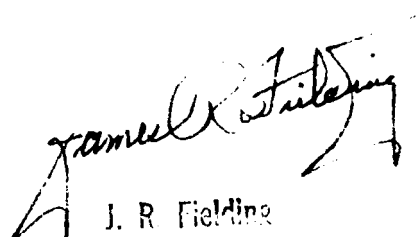
RECD
FWS-Region 2

JUN 7 1984

- A-37** 6. Figure 4: Figure 4 is first mentioned on page 4. The figure should, therefore, follow page 4.
- A-38** 7. Page 4, line 9: Was the leopard darter taken from the **Gillham** Reservoir or from the Cossatot River below the reservoir? Please clarify.
- A-39** 8. Page 8, Major Threats: In order to be consistent with the headings on pages 3 and 5, "Major Threats" should be centered on the page.
- A-40** 9. Page 11, Literature Cited: This section should be the last section of Part II and immediately precede Part III.
- A-41** 10. Page 12, Literature Cited: The reference Maughan, O.E., and R.N. Jones. 1982., does not appear in the text before the Literature Cited section.
- A-42** 11. Page 13: The correct heading is "STEP-DOWN OUTLINE."
- A-43** 12. Page 16, Objective: Add the following to the Objective:
Until research on life history and habitat requirements has been conducted on the leopard darter, quantifiable goals with respect to population numbers cannot be set.
- A-44** 13. Page 32, Task 3.2: Information on pesticide use by agricultural personnel and homeowners should be collected. Pesticide contamination of leopard darter habitat should be monitored.
- A-45** 14. Page 33, Task 3.21: Identification of land protection strategies should be accomplished through the Department of Interior's Land Protection Planning Process. A task should be added for the development of a Land Protection Plan.
- A-46** 15. Implementation Schedule: Refer to the Recovery Planning Guidelines. Include a title page for the Implementation Schedule. The title page should include the definitions for the task priorities, general implementation categories, and abbreviations. Attached are examples from another plan.
- A-47** 16. Implementation Schedule: The Implementation Schedule is not acceptable. Recovery tasks should be identified as specifically as possible because this schedule will become the key for all Service activities (including funding of recovery actions) involved in the recovery of the species. As you know, the review of permit proposals, Section 7 consultations, unsolicited proposals, State Federal Aid Proposals, and all other funding requests will be examined against the recovery plan and corresponding Implementation Schedule. **Subtasks** must be included if the Implementation Schedule is to be useful.

We hope these comments will be helpful in preparing the final draft. If you feel that any of these comments do not warrant revision of this draft, please provide your rationale via a return memorandum prior to the Regional Director's approval. Upon approval, please send a copy of the signature **page**. Also, please send 30 copies of the printed plan when it is available.

Attachments



J. R. Fielding